From the Eastern Bloc:

Principles of planning speed and strength/speed endurance training in sports

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The primary objective of speed and strength training of athletes is to develop speed. Displaying maximal speed throughout an entire event, particularly at the end, places increased demands on the athlete's ability to maintain speed. Thus, planning of speed and strength-oriented training loads must provide for the use of activities and methods, as well as structures of activities, that contribute to developing an athlete's speed and endurance.

The development of speed largely depends on the muscle's power of contraction; that is, the exertion of maximal force in a minimal period. It follows that it is necessary, not only to increase the amount of strength available, but also to improve the ability to utilize it in the smallest possible time frame. The greatest contradiction here is the combining, within the same time period, the two independent functions of speed and strength training—the development of available strength and its utilization under competitive conditions.

A muscle fiber's power of contraction is largely limited by the ability to utilize the energy of elastic deformation of muscles and tendons. Consequently, the objective of speed and strength training designed to develop sustained speed should be the simultaneous and/or sequential development of the muscle structure's strength and the improvement of utilization of energy from elastic deformation. It should be noted that a high level of recuperation of mechanical energy makes it possible to reduce the use of metabolic energy. Thus, an increase in muscle power accompanied by decreased expenditures by energy-producing systems is the fundamental model in which speed is increased and maintained for long periods, i.e. speed endurance. Consequently, the degree to which speed endurance is developed is determined by an increase in capacity and by energy recuperation with stabilized or even decreased energy expenditures, rather than by constantly increasing metabolic capacity.

Planning of training loads in speed and strength training should be guided by the time factor; that is, by the length of periods in a particular sport, by the dynamics of the players' movements and tactics during a game, and by individual demands and strategies of adapting to training loads.

During a training period, the main objective of which is to build the ability to display and sustain speed, a building regime of speed and strength training is used. During competition, where the goal is to maintain a level of performance, a maintenance regime is used.

The dynamics of an athlete's activities during a game make it possible, first, to choose appropriate patterns of training loads and, second, to isolate the basic elements of movement. This aids in determining the nature of how muscles function in order to tailor later training to improve those functions. The process of speed and strength training must take into account the relationship between muscle structure function and the mechanisms of energy supply. In the former there is a tendency to maximize power, and in the latter, to minimize energy expenditures. When using

special strength training methods (the use of overloads) under conditions of special exercise-specific activities, those methods should fully correspond in amplitude and type of motion to the area of working amplitude being emphasized, to the maximum effort and the amount of time it is being exerted, and to the mode of muscle function.

Understanding the mechanisms of adaptation is crucial to planning speed and strength-oriented training loads. The key to moving from short-term to long-term adaptation is the relationship between the functional systems and the cell's genetic apparatus, i.e. catabolic and anabolic processes. Increasing the intensity of training methods entails a heightened reaction by functional systems, which in turn activates the cell's genetic apparatus. Increased activity by the cell's genetic apparatus contributes to the synthesis of the functional system's protein structures. In turn, an increase in the capacity of these structures makes it possible to intensify the training process, leading to a new qualitative level of functional system capacity and genetic apparatus activity.

Developing the capacity of aerobic mechanisms is a necessary condition for athletes such as hockey players in their adaptation to training loads. The great productivity of aerobic sources makes it possible not only to move from short-term to long-term adaptation, but also to increase the speed of recovery processes after training loads. Consequently, during the first phase of the training period, special strength training methods should be applied only in the aerobic zone at the anaerobic threshold (AT) level. When using specialized strength training methods, the lactic acid level should not exceed the upper limits of the anaerobic threshold.

The conservatism of muscle structures as compared with energy supplying systems in the process of adapting to training loads makes it necessary to seek new approaches to organizing training loads throughout an entire year-long cycle. In this instance, a simultaneous/sequential system makes it possible to resolve the conflict between the variability of energy-producing systems and the muscle structure's conservatism in the adaptation process.

The phased nature of adaptational processes makes it possible to discern several independent stages, each lasting four to six weeks, during both the training and competitive periods.

Economy being the basic feature of all adaptational processes, speed and strength training methods must be made increasingly intensive and then replaced after each stage. This ensures functional improvements within an athlete's body and thus an increase in mobility.

Various types of adaptation strategies (and planning, orientation and volume of training loads) may be chosen, depending on time factors, i.e. the length of training and competitive seasons, intervals between events during the season, the number of events, and so forth. In one case, this might involve using a concentrated number of speed and strength loads during a given stage of the training period; in another, a regular increase in intensity of loads accompanied by a reduction of volume. In the first instance there is a reduction of speed and strength parameters during the strength block. These parameters are then increased considerably during a period of reduced volume loads and then maintained at a high level. In the second instance, the increase in the level of the athlete's speed and strength parameters is paralleled by an increase in training load intensity.

The training period consists of two to four phases, each lasting four to six weeks. In the first phase, during the first and second microcycles, the athlete's strength endurance is built through specialized strength training methods. The use of overloads when performing exercise-specific activities (*Translator's note: can also be translated as "technical-tactical exercises"*) should occur in the anaerobic threshold (AT) zone. It is also advisable to use overloads during track and field cross country events in the AT zone. The volume of special strength training methods during the first two microcycles comprises 7 to 10 percent of the overall volume of exercise-specific training.

During the third and fourth microcycles the emphasis shifts from strength endurance to absolute strength. Overloading is used in exercises that require the exertion of maximal speed when performing exercise-specific tasks. Overloading is also used when performing fartleks. The intensity of the fartleks corresponds to the AT zone. These activities comprise 10 to 12 percent of the volume of exercise-specific training. Jumping exercises are used in the process of specialized strength training. In these exercises the emphasis is on the speed of performance (timed hurdles, jumping over a ladder device, and single-leg hops at distances of 30 to 50 meters).

In the fifth and sixth microcycles the main objective of speed and strength training is to develop explosive strength and the athlete's ability to utilize the energy of elastic deformation. When working with weights, the emphasis is on speed of execution with a set range of motion, and on the speed with which muscles move from a nonresistant to resistant mode. Two versions of depth jumps are introduced: the first with a landing angle of 170 degrees, the second at 90 degrees to 110 degrees.

The intensity of the jumping exercises is produced by reducing the time of repetitions and number of jumps during multijumps and single-leg hops at set distances, by increas-

ing the height of the jump (raising hurdles, increasing the number of steps on ladder devices) and by focusing attention on the nonresistant mode of muscle function during imitative movements or when working through specific elements of game-related movements.

The number of repetitions of jumping exercises should be 10 to 15. Overload is used in exercises that require the exertion of maximal speed in performing tactical tasks. Here the emphasis is on developing speed, and therefore, a high concentration of lactate at the upper limit of the aerobic-anaerobic or anaerobic glycolytic zone is not permissible. These should comprise 12 to 15 percent of the overall volume of special training.

Thus, during the first stage, the use of overloading in track and field cross country events and exercise-specific activities at the anaerobic threshold zone created the potential for strength endurance and local muscular endurance. This makes it possible to enhance the muscle structure's oxidative abilities by increasing the speed of utilization of lactate and pyruvate in the working organ. Raising the level of absolute strength provides the necessary preconditions for exerting explosive strength and utilizing the energy from elastic deformation of muscles. The development of explosive strength goes hand in hand with the focused development of an athlete's speed capabilities. The improvement of explosive strength must be logically followed by the ability to maintain it for long periods at a maximal level. With this objective, a range of activities to develop sustained speed and strength is introduced in the first and second microcycles of the second phase.

The emphasis is on jumping exercises with a tendency to gradually reduce the time of execution of the various jumps. The number of jumps is 30 to 50 in one repetition. Gradually increasing the number of jumps makes it possible to perform them at the upper limit of the aerobic-anaerobic zone. Overloading is used in the aerobic-anaerobic zone when performing exercise-specific activities. These exercises should total 15 to 18 percent of overall volume.

A speed and strength endurance program should be used in conjunction with tactical training methods aimed at building an athlete's ability to sustain speed. This combination makes it possible to significantly improve the utilization of energy from elastic deformation on one hand, and to sustain a high output of muscle contraction on the other.

The parallel use of speed and strength methods and special strength training provides an opportunity to simultaneously increase the output of the muscle structure and the ability to use energy from elastic deformation, and to translate this into increased speed and speed endurance.

Depending on the goals of the training process, the third and fourth microcycles can include the parallel use of "explosive strength" and "speed and strength endurance" programs, with a shifting of emphasis to the former. Increasing the intensity of a given set of activities is a prerequisite. The volume of special strength training activities is increased to 18 to 20 percent. A paired set of "explosive strength" and "speed and strength endurance" activities is used in the last two microcycles of the second phase, but with the accent on the second part. The volume of tactical exercises performed with overloading grows to 20 to 22 percent. The gradually increasing volume of special strength training, especially during the second phase, should satisfy the requirement of increasing the athlete's mobility, reducing rest pauses and extending the length and number of repetitions, while stabilizing fluctuations in the energy-supply systems at the AT level or shifting them from the aerobic-anaerobic zone to the AT zone. This is evidence of a constant increase in speed endurance.

It should be emphasized that the use of overloading need not be limited to track and field events and tactical exercises. It can also be used successfully in the process of speed and strength (jumping) training. It is advisable to use it in those microcycles in which absolute strength (fourth microcycle) and speed and strength endurance are being developed (particularly when studying the individual structural, elements of game-specific movements).

The "strength endurance" block incorporates a circular method of training consisting of eight to 12 exercises. The choice of exercises should ensure that all muscle groups are worked. During the first week the weight of overloads should be 50 to 60 percent of maximum, eight exercises, 10 to 20 repetitions, three to four series. In the first series—50 percent—there are 15 repetitions; in the second—50 percent—20 repetitions; in the third—55 percent—15 repetitions, and in the fourth—60 percent—10 repetitions.

In the second microcycle the weight of overloads remains as before—50 to 60 percent. The number of repetitions increases to 30 to 50, three to five series. The number of exercises can be reduced to four to six. In the first series—50 percent—there are 40 repetitions; in the second—50 percent—30 repetitions; in the third —60 percent—30 repetitions, and in the fourth—50 percent—35 repetitions.

A different version of the "strength endurance" block is used every other day: overload weight—70 to 80 percent, number of exercises—six to eight, four to six series. In the first series—70 percent—there are 15 repetitions; in the second—75 percent—10 repetitions; in the third—80 percent—seven repetitions; in the

fourth—75 percent—10 repetitions; in the fifth—70 percent—15 repetitions, and in the sixth—70 percent—as many as possible.

In the first two microcycles, when work is focused on developing strength endurance, jumping exercises are not used. This is associated with the fact that, first, there is a need to increase available strength, second, the tendons are not prepared to withstand "impactive" loads, and third, the development of strength endurance will negatively affect the quality of jumps.

When developing absolute strength, the third and fourth microcycles incorporate four to eight exercises, four to six series, weight of overload 80 to 90 percent, with possible increase to 100 percent.

In the first series—80 percent—there are five repetitions; in the second—85 percent—three repetitions; in the third—90 percent—three repetitions, and in the fourth—95 percent—one repetition. In the fifth and sixth series weight is reduced with an increase in the number of repetitions.

A run with acceleration (five to 10 meters) or jumping exercises with up to 10 repetitions should be included after repetition on the legs.

The "explosive strength" block is structured as follows: weight of overload 50 to 70 percent, number of exercises—six to eight, number of series—four to six. Exercises to develop the leg muscles (squats, bounding, etc.) are performed with jumping exercises. The emphasis is on speed of execution and on switching from nonresistant to resistant muscle function. In the first series—50 percent—there are 10 repetitions; in the second—60 percent—10 repetitions; in the third—70 percent—eight repetitions; in the fourth—60 percent—eight repetitions; in the fifth—50 percent—eight repetitions, and in the sixth—50 percent—six repetitions. Activities are changed every other day or week. Another version is possible: in the first series—50 percent—five repetitions; in the second—60 percent—five repetitions; in the third—70 percent—five repetitions; in the fourth—60 percent—five repetitions; in the fifth—70 percent—five repetitions, in the sixth—50 percent—five repetitions. When building speed and strength endurance, four to six exercises are used, weight of overload—to 30 to 50 percent—three to five series with 20 to 30 repetitions each, jumping exercises up to 50 repetitions. In the first series—30 percent—30 repetitions; in the second—40 percent—25 repetitions; in the third—50 percent—20 repetitions; in the fourth—40 percent—25 repetitions, and in the fifth—30 percent—30 repetitions.

Looking at the second version: In the first series—30 percent—20 repetitions; in the second series—40 percent—20 repetitions; in the third—50 percent—20 repetitions, in the fifth—30 percent—25 repetitions.

In performing all exercises, attention should be given to the speed of execution.

The training period should include four to five training sessions devoted to strength. During the competitive season there should be one to three such sessions, with the number of series reduced by approximately one-third or one-half.●